

CLAIMS

1. A voltage conversion apparatus (100, 100A, 100B, 100C) converting a direct current voltage from a DC power supply (B) into an output voltage such that said output voltage is equal to a designated voltage, comprising:

a voltage converter (12) altering a voltage level of said direct current voltage to provide an output voltage,

detection means (13) detecting the output voltage output from said voltage converter (12), and

control means (52, 52A, 52B, 54, 54A) controlling said voltage converter (12) such that a follow-up property of said output voltage with respect to said designated voltage in said feedback control is consistent with a reference property, and said output voltage is equal to said designated voltage, based on said detected output voltage and said designated voltage.

2. The voltage conversion apparatus according to claim 1, wherein

said voltage converter (12) includes a chopper circuit (Q1, Q2),

said control means (52, 52A, 52B, 54, 54A) comprises

a feedback voltage control value calculation unit (52, 52A, 52B) detecting a difference between said output voltage and said designated voltage to determine a control gain in said feedback control in accordance with the detected difference, and calculating a feedback voltage control value in said feedback control such that said follow-up property is equal to said reference property based on the determined control gain, said output voltage, and said difference,

a duty ratio calculation unit (541) calculating a switching duty ratio of said chopper circuit (Q1, Q2), based on said calculated feedback voltage control value, and

a switching signal generation unit (543) generating a switching signal having said switching duty ratio, and providing the generated switching signal to said chopper

circuit (Q1, Q2).

3. The voltage conversion apparatus according to claim 2, wherein said
feedback voltage control value calculation unit (52, 52A, 52B) calculates said feedback
5 voltage control value by correcting a feedback preliminary voltage control value
calculated using said control gain such that said follow-up property is equal to said
reference property.

4. The voltage conversion apparatus according to claim 3, wherein said
10 feedback voltage control value calculation unit (52, 52A, 52B) comprises
a subtracter (521) calculating a difference between said output voltage and said
designated voltage,

a gain determination unit (522) determining said control gain based on said
difference,

15 a computing element (523, 523A) calculating said feedback preliminary voltage
control value based on said determined control gain, and

a corrector (524, 524A) correcting said feedback preliminary voltage control
value by converting said output voltage into a reference voltage where said follow-up
property is equal to said reference property to output said feedback voltage control
20 value.

5. The voltage conversion apparatus according to claim 4, wherein said
corrector (524, 524A) calculates a ratio of said reference voltage to said output voltage,
and multiplies the calculated result by said feedback preliminary voltage control value to
25 correct said feedback preliminary voltage control value.

6. The voltage conversion apparatus according to claim 2, wherein said
feedback voltage control value calculation unit (52, 52A, 52B) calculates said feedback

voltage control value by correcting said difference such that said follow-up property is equal to said reference property.

5 7. The voltage conversion apparatus according to claim 6, wherein said feedback voltage control value calculation unit (52A) comprises
a subtracter (521) calculating a difference between said output voltage and said designated voltage,
a corrector (524A) correcting said difference such that said follow-up property is equal to said reference property,
10 a gain determination unit (522) determining said control gain based on said difference, and
a computing element (523A) calculating said feedback voltage control value based on said determined control gain and said corrected difference.

15 8. The voltage conversion apparatus according to claim 7, wherein said corrector (524A) corrects said difference by converting said output voltage into a reference voltage where said follow-up property is equal to said reference property.

20 9. The voltage conversion apparatus according to claim 8, wherein said corrector (524A) calculates a ratio of said reference voltage to said output voltage, and corrects said difference by multiplying the calculated result by said difference.

25 10. The voltage conversion apparatus according to claim 1, wherein said voltage converter (12) includes of a chopper circuit (Q1, Q2),
said control means (52, 52A, 52B, 54, 54A) comprises
a feedback voltage control value calculation unit (52, 52A, 52B) detecting a difference between said output voltage and said designated voltage to determine a control gain in said feedback control in accordance with the detected difference, and

calculating a feedback preliminary voltage control value in said feedback control based on the determined control gain, said output voltage, and said difference,

a duty ratio calculation unit (54, 54A) calculating a switching duty ratio of said chopper circuit (Q1, Q2) such that said follow-up property is equal to said reference property, based on said calculated feedback preliminary voltage control value and said output voltage, and

a switching signal generation unit (543) generating a switching signal having said switching duty ratio, and providing the generated switching signal to said chopper circuit (Q1, Q2).

11. The voltage conversion apparatus according to claim 10, wherein said duty ratio calculation unit (54A) calculates said switching duty ratio by correcting a preliminary duty ratio calculated using said feedback preliminary voltage control value such that said follow-up property is equal to said reference property.

12. The voltage conversion apparatus according to claim 11, wherein said duty ratio calculation unit (54A) comprises

a computing element (541) calculating said preliminary duty ratio in accordance with said feedback preliminary voltage control value, and

a corrector (524) correcting said preliminary duty ratio such that said follow-up property is equal to said reference property.

13. The voltage conversion apparatus according to claim 12, wherein said corrector (524) corrects said preliminary duty ratio by converting said output voltage into a reference voltage where said follow-up property is equal to said reference property.

14. The voltage conversion apparatus according to claim 13, wherein said

corrector (524) calculates a ratio of said reference voltage to said output voltage, and corrects said preliminary duty ratio by multiplying the calculated result by said preliminary duty ratio.

5 15. A voltage conversion method of converting a direct current voltage from a DC power supply (B) into an output voltage under feedback control such that said output voltage is equal to a designated voltage, said method comprising:

 a first step of detecting said output voltage,

 a second step of detecting a difference between said designated voltage and said
10 output voltage,

 a third step of determining a control gain in accordance with said detected difference, and

 a fourth step of converting said direct current voltage into said output voltage such that a follow-up property of said output voltage with respect to said designated
15 voltage in said feedback control is consistent with a reference property, and said output voltage is equal to said designated voltage, based on said determined control gain, said detected difference, and said detected output voltage.

 16. The voltage conversion method according to claim 15, wherein
20 said direct current voltage being converted into said output voltage by a chopper circuit (Q1, Q2),

 said fourth step comprises

 a first substep of calculating a feedback voltage control value that causes said follow-up property to match said reference property in said feedback control, based on
25 said control gain, said difference, and said output voltage,

 a second substep of calculating a switching duty ratio of said chopper circuit (Q1, Q2) using said feedback voltage control value, and

 a third substep of controlling said chopper circuit (Q1, Q2) such that said output

voltage is equal to said designated voltage, based on said switching duty ratio.

17. The voltage conversion method according to claim 16, wherein said first substep includes

- 5 the step of calculating a feedback preliminary voltage control value in said feedback control based on said control gain and said difference, and
- the step of calculating said feedback voltage control value by correcting said feedback preliminary voltage control value using said output voltage.

10 18. The voltage conversion method according to claim 17, wherein said step of calculating said feedback voltage control value includes

- the step of calculating a conversion ratio required to convert said output voltage into a reference voltage where said follow-up property is equal to said reference property, and
- 15 the step of multiplying said feedback preliminary voltage control value by said conversion ratio to calculate said feedback voltage control value.

19. The voltage conversion method according to claim 16, wherein said first substep includes

- 20 the step of calculating a correction difference where said follow-up property is equal to said reference property by correcting said difference using said output voltage, and
- the step of calculating said feedback voltage control value based on said control gain and said correction difference.

- 25 20. The voltage conversion method according to claim 19, wherein said step of calculating said correction difference includes
- the step of calculating a conversion ratio required to convert said output voltage

into a reference voltage where said follow-up property is equal to said reference property, and

the step of multiplying said difference by said conversion ratio to calculate said correction difference.

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21. The voltage conversion method according to claim 15, wherein said direct current voltage being converted into said output voltage by a chopper circuit (Q1, Q2), said fourth step comprises

10 a first substep of calculating a feedback preliminary voltage control value in said feedback control based on said control gain and said difference,

a second substep of calculating a preliminary switching duty ratio of said chopper circuit (Q1, Q2) based on said feedback preliminary voltage control value,

15 a third substep of correcting said preliminary switching duty ratio using said output voltage to calculate a switching duty ratio where said follow-up property is equal to said reference property, and

a fourth substep of controlling said chopper circuit (Q1, Q2) such that output voltage is equal to said designated voltage, based on said switching duty ratio.

20 22. The voltage conversion method according to claim 21, wherein said third substep includes

the step of calculating a conversion ratio required to convert said output voltage into a reference voltage where said follow-up property is equal to said reference property, and

25 the step of multiplying said preliminary switching duty ratio by said conversion ratio to calculate said switching duty ratio.

23. A computer-readable recording medium with a program recorded thereon to allow a computer to execute control of voltage conversion of converting a direct

current voltage from a DC power supply (B) into an output voltage under feedback control such that said output voltage is equal to a designated voltage, said computer executing:

a first step of detecting said output voltage,

5 a second step of detecting a difference between said designated voltage and said output voltage,

a third step of determining a control gain in accordance with said detected difference, and

10 a fourth step of converting said direct current voltage into said output voltage such that a follow-up property of said output voltage with respect to said designated voltage in said feedback control is consistent with a reference property, and said output voltage is equal to said designated voltage, based on said determined control gain, said detected difference, and said detected output voltage.

15 24. The computer-readable recording medium recorded with a program thereon to be executed by a computer according to claim 23, wherein

said direct current voltage being converted into said output voltage by a chopper circuit (Q1, Q2),

said fourth step comprises

20 a first substep of calculating a feedback voltage control value that causes said follow-up property to match said reference property in said feedback control, based on said control gain, said difference, and said output voltage,

a second substep of calculating a switching duty ratio of said chopper circuit (Q1, Q2) using said feedback voltage control value, and

25 a third substep of controlling said chopper circuit (Q1, Q2) such that said output voltage is equal to said designated voltage, based on said switching duty ratio.

25. The computer-readable recording medium recorded with a program

thereon to be executed by a computer according to claim 24, wherein said first substep includes

the step of calculating a feedback preliminary voltage control value in said feedback control based on said control gain and said difference, and

5 the step of calculating said feedback voltage control value by correcting said feedback preliminary voltage control value using said output voltage.

26. The computer-readable recording medium recorded with a program thereon to be executed by a computer according to claim 25, wherein said step of
10 calculating said feedback voltage control value includes

the step of calculating a conversion ratio required to convert said output voltage into a reference voltage where said follow-up property is equal to said reference property, and

15 the step of multiplying said feedback preliminary voltage control value by said conversion ratio to calculate said feedback voltage control value.

27. The computer-readable recording medium recorded with a program thereon to be executed by a computer according to claim 24, wherein said first substep includes

20 the step of calculating a correction difference where said follow-up property is equal to said reference property by correcting said difference using said output voltage, and

the step of calculating said feedback voltage control value based on said control gain and said correction difference.

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28. The computer-readable recording medium recorded with a program thereon to be executed by a computer according to claim 27, wherein said step of calculating said correction difference includes

the step of calculating a conversion ratio required to convert said output voltage into a reference voltage where said follow-up property is equal to said reference property, and

5 the step of multiplying said difference by said conversion ratio to calculate said correction difference.

29. The computer-readable recording medium recorded with a program thereon to be executed by a computer according to claim 23, wherein

10 said direct current voltage being converted into said output voltage by a chopper circuit (Q1, Q2),

said fourth step comprises

a first substep of calculating a feedback preliminary voltage control value in said feedback control based on said control gain and said difference,

15 a second substep of calculating a preliminary switching duty ratio of said chopper circuit (Q1, Q2) based on said feedback preliminary voltage control value,

a third substep of correcting said preliminary switching duty ratio using said output voltage to calculate a switching duty ratio where said follow-up property is equal to said reference property, and

20 a fourth substep of controlling said chopper circuit (Q1, Q2) such that output voltage is equal to said designated voltage, based on said switching duty ratio.

30. The computer-readable recording medium recorded with a program thereon to be executed by a computer according to claim 29, wherein said third substep includes

25 the step of calculating a conversion ratio required to convert said output voltage into a reference voltage where said follow-up property is equal to said reference property, and

the step of multiplying said preliminary switching duty ratio by said conversion ratio to calculate said switching duty ratio.

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